U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY—BULLETIN No. 109, Part V.
L. O. HOWARD, Entomologist and Chief of Bureau.

PAPERS ON INSECTS AFFECTING VEGETABLES.

ARSENITE OF ZINC AND LEAD CHROMATE AS REMEDIES AGAINST THE COLORADO POTATO BEETLE.

BY

FRED A. JOHNSTON,
Entomological Assistant.
[In cooperation with the Virginia Truck Experiment Station.]

ISSUED APRIL 5, 1912.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

BUREAU OF ENTOMOLOGY.

L. O. Howard, *Entomologist and Chief of Bureau.*
C. L. Marlatt, *Entomologist and Acting Chief in Absence of Chief.*
R. S. Clifton, *Executive Assistant.*
W. F. Tastet, *Chief Clerk.*

F. H. Chittenden, *in charge of truck crop and stored product insect investigations.*
A. D. Hopkins, *in charge of forest insect investigations.*
W. D. Hunter, *in charge of southern field crop insect investigations.*
F. M. Webster, *in charge of cereal and forage insect investigations.*
A. L. Quaintance, *in charge of deciduous fruit insect investigations.*
E. F. Phillips, *in charge of bee culture.*
D. M. Rogers, *in charge of preventing spread of moths, field work.*
Rolla P. Currie, *in charge of editorial work.*
Mabel Colcord, *in charge of library.*

Truck Crop and Stored Product Insect Investigations.

F. H. Chittenden, *in charge.*

H. M. Russell, C. H. Popenoe, Wm. B. Parker, H. O. Marsh, M. M. High, Fred A. Johnston, John E. Graf, *entomological assistants.*
I. J. Condit, *collaborator in California.*
P. T. Cole, *collaborator in tidewater Virginia.*
W. N. Ord, *collaborator in Oregon.*
Thos. H. Jones, *collaborator in Porto Rico.*
Marion T. Van Horn, Pauline M. Johnson, *preparators.*

CONTENTS

PAPERS ON INSECTS AFFECTING VEGETABLES.

ARSENITE OF ZINC AND LEAD CHROMATE AS REMEDIES AGAINST THE COLORADO POTATO BEETLE.

By Fred A. Johnston, *Entomological Assistant.*

[In cooperation with the Virginia Truck Experiment Station.]

SPRAYING EXPERIMENTS WITH ARSENITE OF ZINC AND LEAD CHROMATE IN COMPARISON WITH OTHER ARSENICALS.

In May, 1911, a series of experiments for comparing the insecticidal value of arsenite of zinc and of lead chromate with that of other arsenicals in controlling the Colorado potato beetle (*Leptinotarsa decemlineata* Say) was undertaken under the direction of Dr. F. H. Chittenden at the Virginia Truck Experiment Station, at Norfolk, Va.

The season was later than usual, making it unnecessary to spray for the potato beetle until about May 9. At this date no larvæ were present on the plants, though beetles and egg masses were abundant.

On May 9 six plats were sprayed. Table I gives the insecticides and strengths used.

Table I.—*Sprays used against the Colorado potato beetle, Norfolk, Va., May, 1911.*

Plat No.	Insecticide used.
I	Lime-sulphur, 2 pounds to 50 gallons of water and 3 pounds of arsenate of lead.
II	Arsenate of lead, 3 pounds to 50 gallons of water.
III	Lead chromate, 2 ounces to 4 gallons of water.
IV	Arsenite of zinc, 1½ pounds to 50 gallons of water.
V	Bordeaux mixture (4–6–50 formula) and 1½ pounds of Paris green.
VI	Bordeaux mixture (4–6–50 formula) and 1½ pounds of arsenite of zinc.

On May 22 all of the potatoes were resprayed, the same proportions of the different materials being used with the exception of the lead chromate in which case the strength was doubled. (One ounce to a gallon of water.)

At this date the larvæ were exceedingly numerous and doing much damage in unsprayed potato fields.

On the day following the second application of the sprays a count of the infested plants in each plat was made and the following figures obtained:

TABLE II.—*Results of spray applications against the Colorado potato beetle, Norfolk, Va., May, 1911.*

Plat No.	Insecticide used.	Number of infested plants.	Number of uninfested plants.	Infestation.
				Per cent.
I	Lime-sulphur (2–50 formula) and 3 pounds of arsenate of lead	37	347	9.6
II	Arsenate of lead, 3 pounds to 50 gallons of water	118	622	15.9
III	Lead chromate, 2 ounces to 4 gallons of water, and 1 ounce to 1 gallon of water	216	169	+56.0
IV	Arsenite of zinc, 1½ pounds to 50 gallons of water	206	1,048	16.4
V	Bordeaux mixture (4–6–50 formula) and 1½ pounds Paris green	152	741	+17.0
VI	Bordeaux mixture (4–6–50 formula) and 1½ pounds arsenite of zinc	225	555	28.8

It will be seen that the results obtained from the use of lead chromate were very unsatisfactory as compared with those in the case of other insecticides used. The lead chromate employed was in the form of a powder, and great difficulty was experienced in making it mix well with water, it having a tendency to settle quite rapidly, requiring constant agitation to keep it in solution. It adhered well to the foliage, and its color stood out quite prominently in contrast to the other plats. However, the young larvæ seemed to be able to feed on plants that were thoroughly covered with the material without receiving much injury.

The arsenite of zinc employed was also in the powdered form. It is much lighter than lead chromate and remains in suspension in water much better. It adheres to the foliage very well and does not, so far as could be observed, burn or injure the plants in any way.

The percentage of infested plants in the plat that was treated with Bordeaux mixture and arsenite of zinc was somewhat greater than in the plat in which the arsenite of zinc alone had been used. This was no doubt due partly to the fact that the Bordeaux-arsenite of zinc plat was in a different field, one which had been in potatoes the previous year and was thus subject to the attack of a greater number of beetles. Also, many of the plants which were counted as infested were only slightly injured, and it is doubtful if the yield of potatoes would have been much lessened.

On June 29 the potatoes were dug, and following are the weights of one row of potatoes in each of the first four plats.

TABLE III.— *Yields of potatoes from one row from each of Plats I, II, III, and IV, sprayed as indicated in Table I.*

One row from plat No.	Insecticide used.	Number of plants in row.	Weight of No. 1 potatoes.[1]	Weight of No. 2 potatoes.[2]
			Pounds.	*Pounds.*
I	Lime-sulphur and arsenate of lead	384	188½	25¾
II	Arsenate of lead	368	172¾	26
III	Lead chromate	385	128	19¾
IV	Arsenite of zinc	374	143½	18

[1] Excellent to good. [2] Fair to indifferent.

By taking the yield of the same number of plants from each row the contrast between the different rows will be more marked. Table IV represents the yield of 374 plants from each row:

TABLE IV.— *Yields of potatoes from 374 plants from one row from each of Plats I, II, III, and IV, sprayed as indicated in Table I.*

One row from plat No.	Insecticide used.	Number of plants in row.	Weight of No. 1 potatoes.[1]	Weight of No. 2 potatoes.[2]
			Pounds.	*Pounds.*
I	Lime-sulphur and arsenate of lead	374	183.26	25.05
II	Arsenate of lead	374	175.401	26.18
III	Lead chromate	374	124.168	19.07
IV	Arsenite of zinc	374	143.5	18

[1] Excellent to good. [2] Fair to indifferent.

SPRAYING EXPERIMENTS WITH ARSENITE OF ZINC AT VARIOUS STRENGTHS.

An experiment with the three following strengths of arsenite of zinc in controlling the Colorado potato beetle was begun at the Virginia Truck Experiment Station, Norfolk, Va., on May 31, 1911.

No. I, arsenite of zinc, 1 pound to 50 gallons of water.
No. II, arsenite of zinc, 1½ pounds to 50 gallons of water.
No. III, arsenite of zinc, 2 pounds to 50 gallons of water.

On the day the spraying was done (May 31) the rows sprayed with No. I, No. II, and No. III had 47, 86, and 88 infested plants, respectively.

On June 2 the row treated with No. I had 33 infested plants, a decreased infestation of 14 plants, or 29.8 per cent. The row treated with No. II had 57 infested plants, a decreased infestation of 29 plants, or 33.7 per cent, while the row treated with No. III had 38 infested plants, a decreased infestation of 50 plants, or 56.8 per cent.

On June 3 the count was again taken, and the row treated with No. I had 15 infested plants, a decreased infestation of 32 plants, or 68+ per cent. The row treated with No. II had 23 infested plants, a decreased infestation of 63 plants, or 73.2 per cent, while the row treated with No. III had 13 infested plants, a decreased infestation of 75 plants, or 85.2 per cent.

The following table shows the number of infested plants in the plats before and after spraying:

TABLE V.—*Results of applications of arsenite of zinc at different strengths against the Colorado potato beetle.*

Date.	Solution No.	Number of infested plants.	Decrease in number of infested plants.	Decrease of infestation.
1911.				*Per cent.*
May 31	I	47		
Do	II	86		
Do	III	88		
June 2	I	33	14	29.8
Do	II	57	29	33.7
Do	III	38	50	56.8
June 3	I	15	32	68+
Do	II	23	63	73.2
Do	III	13	75	85.2

On June 3 the number of larvæ on the plants which were still infested was much smaller than the number present when the spray was first applied. The extent of infestation of some plants amounted to but one or two larvæ; these plants, however, were counted in as infested.

Results.—From the preceding table it will be seen that far better results were obtained where 2 pounds of arsenite of zinc to 50 gallons of water were used.

The results were obtained more quickly, and a larger percentage of larvæ was killed. At this strength arsenite of zinc did not burn or injure the foliage in any way, and without doubt an even greater amount of the arsenical might be used without injury to the plants and with correspondingly greater efficiency in killing the beetles.

ADDITIONAL COPIES of this publication may be procured from the SUPERINTENDENT OF DOCUMENTS, Government Printing Office, Washington, D. C., at 5 cents per copy